

is largely useless to the historian of science, as it empties the methodological claims made in the preface by the editors, who say they are searching for the 19th-century context within which Thomson's labours were temporally shaped and rendered reasonable.

One last concern has to do with the holism (or lack thereof) of the book. In the preface, the editors note that each chapter is self-contained. Therefore, they say, some repetition across chapters occurs, although "this small price is worth paying" (p. ix) in return for the diversity of contributions offered. On the contrary, I would argue, this is not a "small price to pay." Self-contained chapters are not, in and of themselves, problematic; but in an edited collection of this sort, the reader is best served by the creation of some holistic integration across sections and chapters. In the present case, the unnecessary repetition of basic life details, including items regarding Thomson's early childhood, his father's career outline, his studies at Cambridge, and his early publications, are repeated *ad nauseam* in differing chapters (in particular in the first section of the book). One is left wondering why the simple technique of cross-referencing between chapters was not employed more thoroughly? Cross-referencing, along with a conscious effort to thematically link chapters, would have helped to create a greater sense of fluid composition, rather than the seeming patchwork of selections that is currently presented. In fact, the only chapter in the entire book that attempts to link the other chapters to one another is Andrew Whitaker's "Kelvin—The Legacy," which appears at the very end as a summary chapter.

While its inclusion of well-informed historical surveys of Thomson's varied works makes *Kelvin: Life, Labours and Legacy* a useful contribution to the history of 19th-century science, the weaknesses of the overall package lead this reviewer to conclude that, at £55, those interested in the history of Thomson would do better to wait until their local library gets a copy.

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Available online 24 October 2009

doi:10.1016/j.hm.2009.07.009

Plato's Ghost: The Modernist Transformation of Mathematics

By Jeremy Gray. Princeton (Princeton University Press). 2008. ISBN 978-0-691-13610-3. 515 pp. \$45.00.

In this ambitious volume, the prolific historian of mathematics Jeremy Gray argues that mathematics underwent a "modernist transformation" in the period from 1890 to 1930.

Tracing developments in the three core areas of geometry, analysis and algebra, as well as philosophy and logic, Gray makes the case for a long-term modernist transformation with gradual beginnings and a culmination around 1900. The individual titles of Chapters 2–4 reveal Gray's strategy to substantiate his claim: "Before Modernism," "Mathematical Modernism Arrives," and "Modernism Avowed." Within each of these three main chapters, Gray presents the mathematics in essentially the same order so readers can approach the individual parts, the whole, or something in between.

Following this central part of the book, Gray "widen[s] the picture" (p. 6) and explores the interface between mathematics and physics, the theory of measurement, the popularization of mathematics, the connections between mathematics and language, and what he calls the "vexed" (p. 6) subject of the psychology of mathematics. Finally, since the First World War "changed the intellectual landscape in many ways" (p. 6), Gray devotes his last chapter to an exploration of how some of these ideas took shape after the war. In this closing chapter he asks "did modernism win?" (p. 452).

Let's follow one of these core subjects through Gray's "before," "arrival" and "avowed" argument. In algebra, for example, Gray intentionally avoids the classic case of Emmy Noether and her school because it would place too many "demands" on his reader (p. 13). Instead, he follows the approaches to proving Fermat's Last Theorem (pointing out that it was not a theorem, nor was it Fermat's "last"). "Before Modernism," work on this most famous example from algebraic number theory was done on a case-by-case basis, with each case more difficult than the one before. It became clear that "a new approach was needed if the general problem was ever to be solved" (p. 76). This "new approach" involved a literal who's-who of German mathematicians and "stretched the familiar concept of integer and the multiplicative properties of integers (divisibility, prime factor) to breaking point" (p. 78).

In Gray's argument, it was Dedekind's introduction of ideal numbers that helped to situate algebraic number theory in a more modern frame. Dedekind's revised theory emphasized more "generality and uniformity... which should apply to all sorts of rings of algebraic integers" (p. 149). It was, then, as Gray suggests, "research questions" that pushed mathematicians to identify "some key properties of objects as integerlike" (p. 151). This emphasis on the qualities and characteristics of integers, rather than the integers themselves, set the modern approach apart from more traditional tactics.

To "avow" the presence of this modern approach, Gray discusses the mathematical research that led to the development of group theory, most notably solutions to general polynomial equations. In his *Traité des substitutions et des équations algébriques*, Camille Jordan "took the opportunity in presenting Galois's ideas to extend and deepen them and in so doing to show that there was a new subject, the study of groups" (p. 214). Once identified, groups took on a life of their own. The study of finite groups grew out of this more abstract approach. The classification of finite groups led to the study of simple groups and, around 1900, the American mathematician Leonard Dickson "established the existence of four infinite families of simple groups" (p. 215). Not surprisingly, Dickson had traveled from the University of Chicago to France and Germany to study with Jordan and Sophus Lie, among others, in the 1896–1897 academic year [Anonymous, 1899]. Given the youth of the American mathematical community at the time, Dickson's presence only further contributes to Gray's notion of modernization. As Gray puts it, "mathematicians who worked in various aspects of group theory other than Jordan were drawn from every country of the mathematical world, and the number of mathematicians who contributed to the enterprise

one way or another shows how important group theory had become” (p. 215).¹ “Group theory,” Gray argues, “as a structural, abstract [modern] branch of mathematics, had arrived” (p. 215).

Gray’s algebra discussion will also introduce readers not acquainted with mathematics to the essence of mathematical research. This point calls attention to the book’s (intended) potential to draw in readers outside mathematics. An even more important example comes from Gray’s introduction where he raises the crucial question of “how, if at all, were the forces promoting modernism in mathematics related to the better-known modernisms of twentieth-century cultural life?” (p. 7). This question is essential on a number of levels. It creates a clear point of departure for historians of other sciences—and, dare this reviewer say it—other disciplines to begin meaningful conversations across fairly rigid boundaries that would do well to become a little softer, and, perhaps even blurry. (Kohler [2005] has offered similar encouragement.) It also suggests meaningful lines of further investigation. In particular, while Gray posits that the modernization of mathematics shared similar characteristics with the modernization of the more well-known artistic areas, he does “not claim that the modernization of mathematics was part of a broader cultural push, animated by concurrent changes in the arts” (p. 14). A thought from Allan Janik and Stephen Toulmin’s *Wittgenstein’s Vienna* might prove a helpful place to begin to consider an alternative perspective. “It comes as a slight shock,” Janik and Toulmin assert,

to discover that [in *fin-de-siècle* Vienna] Anton Bruckner gave piano lessons to Ludwig Boltzmann; that Gustav Mahler would bring his psychological problems to Dr. Freud; that Breuer was Brentano’s physician; that the young Freud fought a duel with the young Viktor Adler, who had attended the same high school as both the last of the Habsburgs, Charles I, and Arthur Seyss-Inquart, later the Nazi Commissioner of Holland; and that Adler himself, like Schnitzler and Freud, had been an assistant in Meynert’s clinic...any of the city’s cultural leaders could make the acquaintance of any other without difficulty [Janik and Toulmin, 1996, 92].

Perhaps the energy of this cross-fertilization of ideas in *fin-de-siècle* Vienna did, somehow, give mathematics a “push” at that time and in that place. That line of investigation would begin, in turn, to address important open questions raised by Allan Janik [Janik, 2001].

Finally, and perhaps best of all, *Plato’s Ghost* may be the only text on mathematics that links the author of *Moby Dick* with an enigmatic American logician: “For Hermann Melville, read C.S. Peirce” (p. 7). But of course, to understand this clever sentence you will have to read *Plato’s Ghost*.

References

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¹ This discussion calls to mind Gray’s points on the communication of ideas: Who spoke? Who listened? Who acknowledged? What became of it? (p. 32) and “...it is not individual works that change the world, but the messages they convey. Those messages go from people to people and, to succeed, must articulate genuine concerns that are also expressed elsewhere. The intellectual concerns therefore must be those of people able to advance them, and so those of significant groups of people with the right opportunities.” (p. 5).

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Available online 8 October 2009

doi:10.1016/j.hm.2009.07.003